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neous so far as our purposes here are concerned. The streams scarcely flow in their beds, and the country is monotonously level. The locality receives about five inches more rain per year than either of the first two, and five inches less than the third, farther to the northeast.* It has not been exposed to the weather longer than the third, and has received less rainfall. The abundance of vegetation is similar in the last two regions, save the fact that trees are almost wanting in Sumner county. Consequently we must attribute the great difference in topography to the presence of limestone in the one and the absence of it in the other.

Thus there is a varied topography, which difference of structure, together with slight difference of climatic conditions, has produced in a comparatively level plain.

NOTICE OF SOME VERTEBRATE REMAINS FROM THE KANSAS PERMIAN.

By S. W. WILLISTON, Lawrence, Kan. Read before the Academy January 2, 1897.

Some months ago numerous fragments of bones, obtained from an excavation of a well in Cowley county, were sent me for examination by Mr. C. N. Gould. The horizon whence the bones came was clearly lower Permian, not far from its base, as accepted by Professor Prosser, the recognized authority on the Kansas Permian stratigraphy.

Not knowing whether additional material will be obtainable, I give here a description of some of these bones, which will be more fully illustrated in the future should no better specimens be secured.

An intercentrum clearly belongs to the genus *Cricotus*, and is closely allied to the typical species described by Cope from the Permian of Illinois.† His description applies so well to the specimen in hand that I use his language, amended:

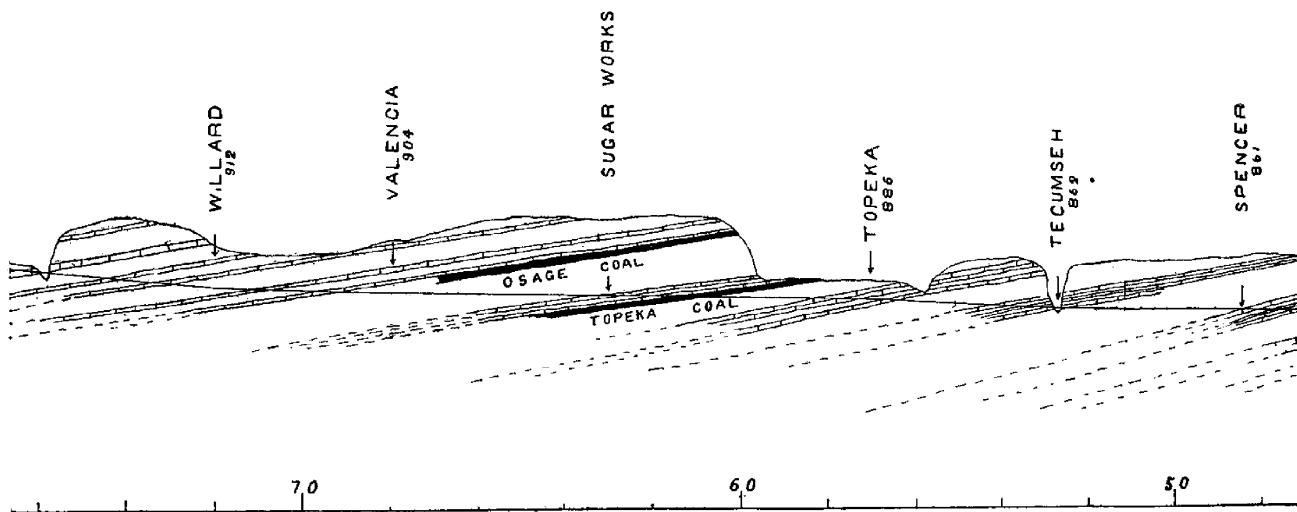
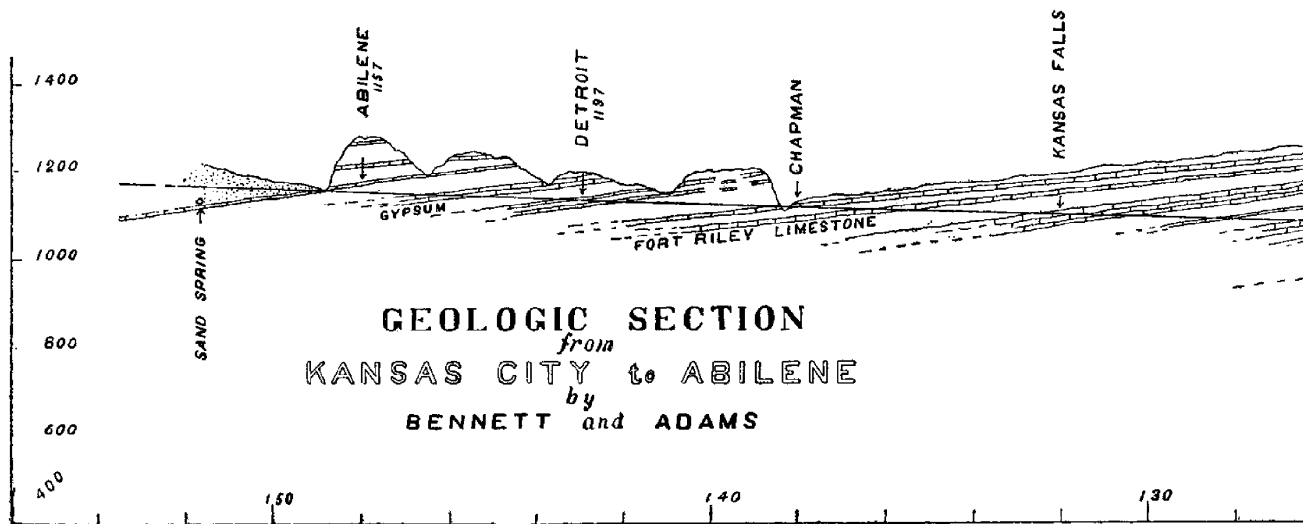
"The caudal intercentrum best preserved is short, discoidal in form, and deeper than wide. The articular faces are deeply concave, the posterior more strongly so, and the middle is occupied by a foramen, whose diameter is about equal to one-half that of the intercentrum on either side. The lateral borders of the posterior articular face are less rounded than the anterior ones. The chevrons are slender and directed very obliquely backward, and their bases are firmly coössified with the intercentrum. On the superior surface two shallow pits occupy considerable space. They are separated by an obtuse ridge, and are bordered by a raised ridge from the polished layer of the lateral surface. Several phalanges of short, wide proportions show much resemblance to those of certain dinosaurs."

Diameter of intercentrum, vertical	18 mm.
Diameter of intercentrum, transverse . .	17 "
Diameter of intercentrum, longitudinal, 11	"
Proximal width of phalanges . . 12 12 13	mm.
Proximal depth of phalanges . . 8 7 6	"
Length of phalanges 14 15 11	"

Another vertebra of smaller size doubtless represents a true centrum (see Cope, Trans. Amer. Phil. Soc., XVI, p. 245). It differs very materially in having remote sutural surfaces for the attachment of the neural arches, in being some-

* Rep. Board Irr. Surv. and Exp. Kan. for 1895-'96, p. 195.

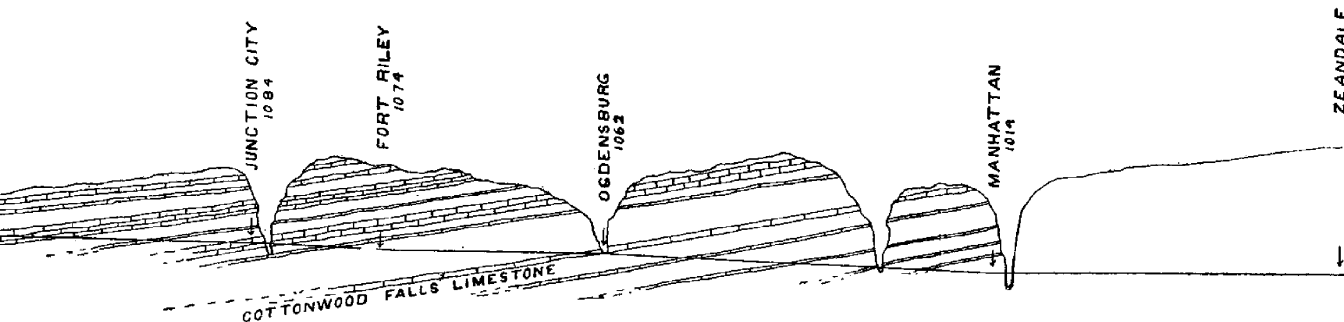
† Proc. Acad. Nat. Sci. Phila., 1875, p. 405.



GEOLOGIC

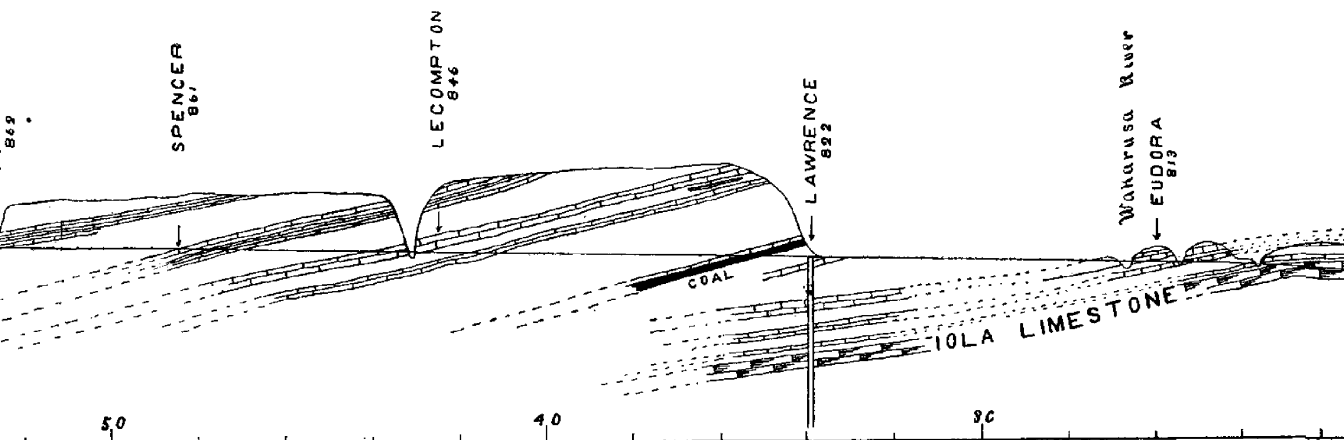
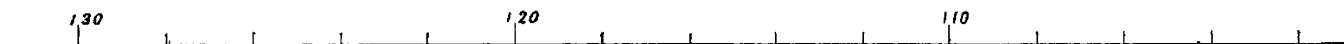
EXPLANATION OF PLATE IX.—This section (from Univ. Geol. Surv. Kan., vol. I, p. 100).
 The east side of the section is to the right.

PLATE IX.



SCALES

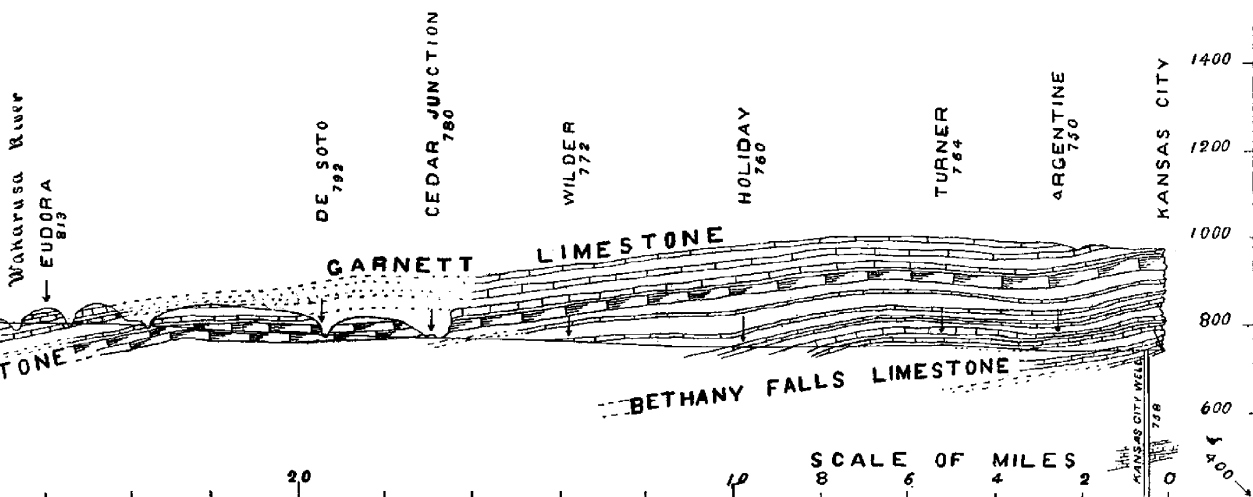
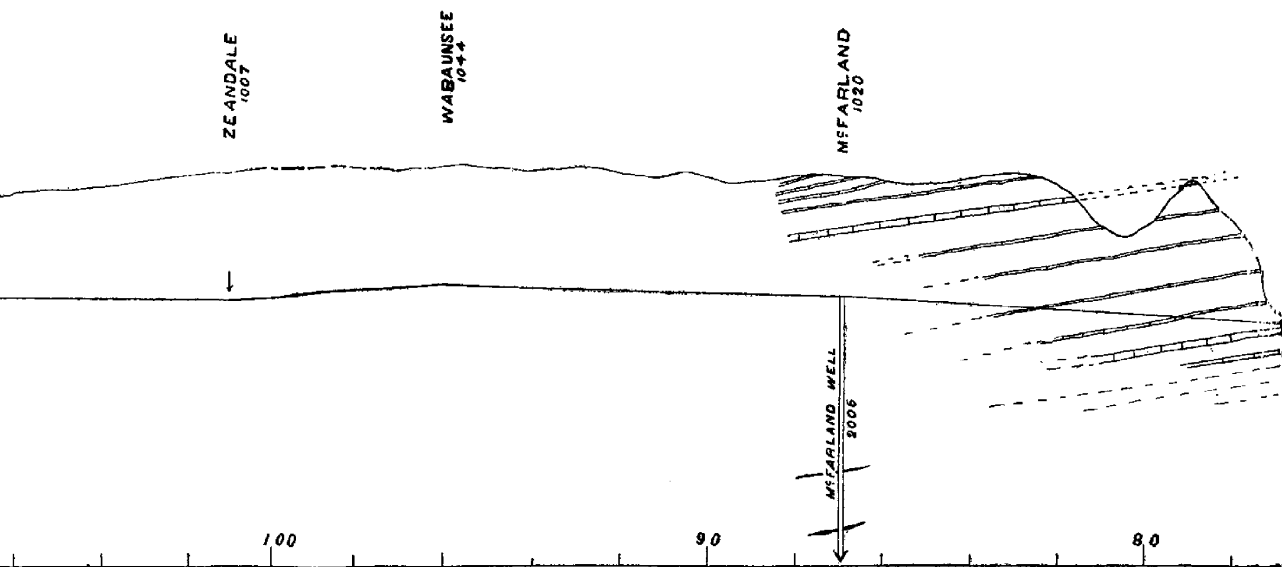
HORIZONTAL ONE INCH 5 MILES
VERTICAL ONE INCH 500 FEET



(From University Geological Survey, Vol. I.)

GEOLOGIC SECTION FROM KANSAS CITY WEST OF ABILENE, KANSAS.

Surv. Kan., vol. I, pl. 6) extends from Abilene along the Kansas river to Kansas City. It represents in a degree the
The eastern extremities of the bluffs are limestone-capped, and the strata dip to the west.



KSAS.

resents in a degree the peculiar nature of the topography to which this paper refers.
e west.

what cordate in shape, and in showing no surfaces for articulation of the chevrons. The ends are concave as in the intercentrum, and the notochordal foramen is of the same relative size. The anterior lips of the cup are more beveled than the posterior ones. The outer surface is concave longitudinally, with an obtuse keel below. The posterior sutural surface for the arch is much larger than the anterior. There are no longitudinal ridges on the sides of the centrum, as shown in the figures of *C. crassidiscus* Cope (labeled *C. heteroclitus* by Zittel). The floor of the neural canal is flat.

Transverse diameter of centrum.....	15 mm.
Vertical diameter of centrum	13 "
Length of centrum.....	7 "
Width of neural surface.....	5 "

Numerous portions of sculptured scutes and plates and a fragment of a jaw with one complete tooth I doubt not belong with the vertebrae.

None of the characters are sufficient to distinguish the species from the other described ones, especially *C. heteroclitus* Cope.

A single dorsal vertebra, and perhaps some phalanges, belong clearly to the genus *Clepsydrops* Cope, also originally described from Illinois, and are closely allied to the typical species. In its description I follow Cope's language in the paper first cited for a dorsal centrum: "It is deeply biconcave, the articular cavities being funnel-shaped and continuous, thus perforating the entire length of the centrum. . . . The cavities communicate by a very small orifice. In an anterior dorsal the anterior cavity is as widely excavated at the border as the posterior funnel. Another peculiarity is the absence of the processes of the centrum, and a small caputular articulation is seen sessile on the border of the cup of two of the dorsals. The dorsal vertebrae have their sides somewhat contracted. In one specimen the inferior face is longitudinally acute. In this dorsal the floor of the neural canal is interrupted by a deep fissure, which has a triangular shape, with the apex downward when seen in profile. The diapophysis does not project far beyond the base of the neural arch." It is sessile, with an elongated, cupped articular surface.

The phalanges are of more slender form than those of *Cricotus*. The shaft is depressed and the distal condyle is not emarginate.

Length of centrum	15	14 mm.
Depth behind	14	12 "
Width behind.....	14	12 "
Length of phalange.....	13	"
Depth, proximally.....	5	"
Width, proximally.....	8	"

As will be seen, the centrum, while nearly the same size as that measured by Cope of *C. collettii* (second column), are of somewhat different proportions, but not sufficiently so to justify specific separation.

Associated with these remains are numerous teeth and spines of *Pleuracanthus* (*Didymodus* ?) and plates of a ganoid fish.

All together, we have here an interesting series of forms, so closely resembling the species described by Cope from Danville, Ill., that I cannot distinguish them specifically. It would seem to demonstrate the contemporaneity of the two formations, and also that of the Texas Permian, whence the species of all these genera have been described by Cope.

Above the stratum in which these bones are found are several hundred feet of limestones and shales, above which come the red beds of Clark and Comanche

counties, which have been variously referred to the Permian and Trias. That this basal Permian fauna continued throughout all the time represented by 800 or 1,000 feet of deposits does not seem probable to me, and I believe yet more strongly what I always have believed, that the red beds in Kansas are Triassic in age. If they be Triassic, and corresponding to the red outcrops in the foothills in Colorado, it would seem strange that the intervening deposits between them and the Dakota, in the regions separated by only a few hundred miles, and agreeing in many lithological characters, should be in one case Cretaceous and in the other Jurassic.

GYPSUM IN KANSAS.

By G. P. GRIMSLEY, Topeka, Kan. Read (by title) before the Academy January 2, 1897.

HISTORICAL INTRODUCTION.

Gypsum (sulphate of lime), from two Greek words, *ge* (earth) and *epso* (to concoct), is a mineral that has attracted attention from very early times. The transparent variety, known as selenite, was used by the ancients as a substitute for glass in windows. The best varieties were supposed to be in upper Egypt and in Syria. It was also in favor for ornamental boxes, and for urns, in which lighted lamps were placed, and so threw a soft light through the apartments. The walls of the temple Fortuna Seia were made of compact gypsum, and the interior, though without windows, is described as "sufficiently lighted by rays transmitted through the semi-pellucid walls." The writings of Theophrastus show that the Greeks were familiar with the use of plaster of Paris, made from calcining the gypsine stone in making casts. The term "alabaster" is commonly noted in the ancient writings, and sometimes refers to compact gypsum and sometimes to the stalactite carbonate of lime, so that it is often difficult to tell from the meager descriptions which is intended.

The earliest account of the use of gypsum as a fertilizer in the ground form known as land plaster is in 1768, when a German clergyman, by name of Mayer, used it with success. After this time there were numerous experiments made to test its efficiency, and the faith of the workers along this line gave the appearance of wonderful results. Thus, one writes that "the invariable results of several experiments incontestably prove that there is a most powerful and subtle principle in this tasteless stone, but by what peculiar agency or combination it is capable of forcing vegetation in such an instantaneous and astonishing manner is a mystery which time reserves for others to unfold."

VARIETIES.

Gypsum in nature occurs in five forms, all of which are found in Kansas:

1. The earthy form, yellow or gray in color, and composed of loose, dust-like particles, rather light in weight, and formed from solution of gypsum in water.
2. The compact variety, including alabaster and massive gypsum, which is very soft and of specific gravity 2.2 or near.
3. Fibrous gypsum or satin-spar, usually found in thin layers, in the form of fine needles or prisms.
4. Foliated gypsum, sometimes massive, but usually in small concretionary masses.
5. Spar gypsum or selenite, found in transparent crystals.

WHERE FOUND.

Gypsum is found in Thuringia, Saxony, Norway, at Mont Martre, near Paris, in Austria, Bohemia, Italy, Egypt, Arabia, Persia, and many other places in the old country. In the United States it is found along an east and west line in cen-